



ENGINEERING SCALE TESTING OF ROBOTIC INSPECTION TOOLS FOR DOUBLE SHELL TANKS AT HANFORD

Michael DiBono

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TEAM MEMBERS



Principal Investigator: Leonel Lagos, P.h.D., PMP

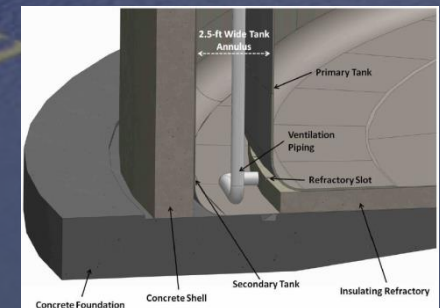
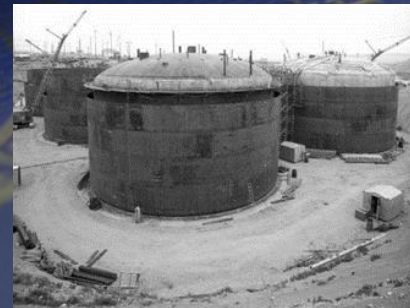
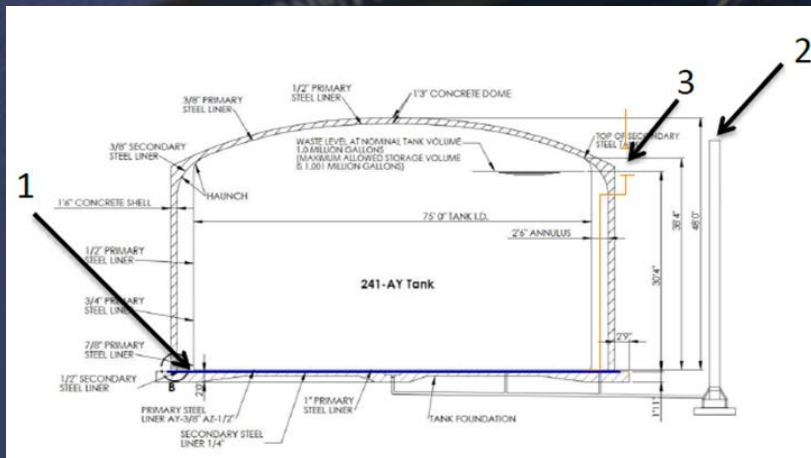
Project Manager: Dwayne McDaniel, Ph.D., P.E.

Technical Staff: Anthony Abrahao, Dr. William Tan

DOE Fellows: Sebastian Zanlongo, Mackenson Telusma, Anibal Morales, Christopher Excellent, Manuel Losada, Michael DiBono

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TASK DESCRIPTION

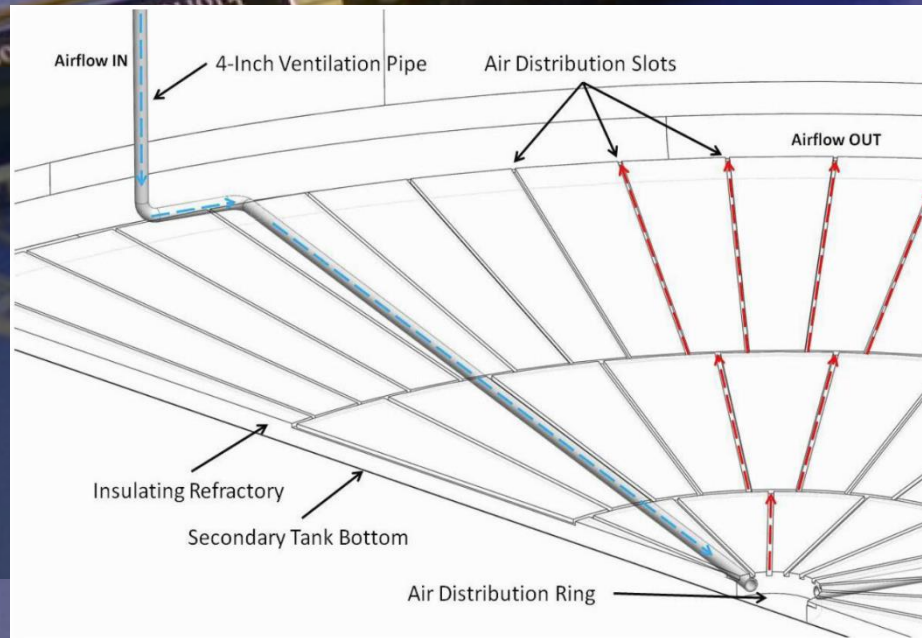


1.) Refractory Air Slots through the Annulus

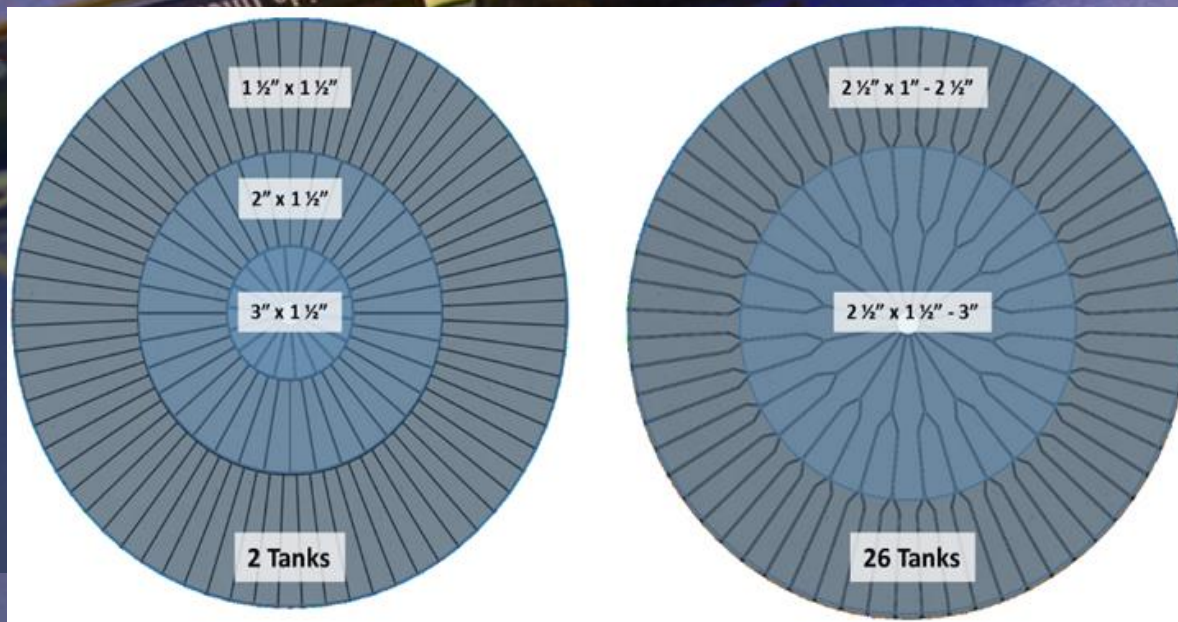
2.) 6" Leak Detection Piping

3.) 4" Air Supply Piping

PROPOSED INSPECTION



PROPOSED INSPECTION



PIPE CRAWLER AIR SUPPLY LINE INSPECTION TOOL

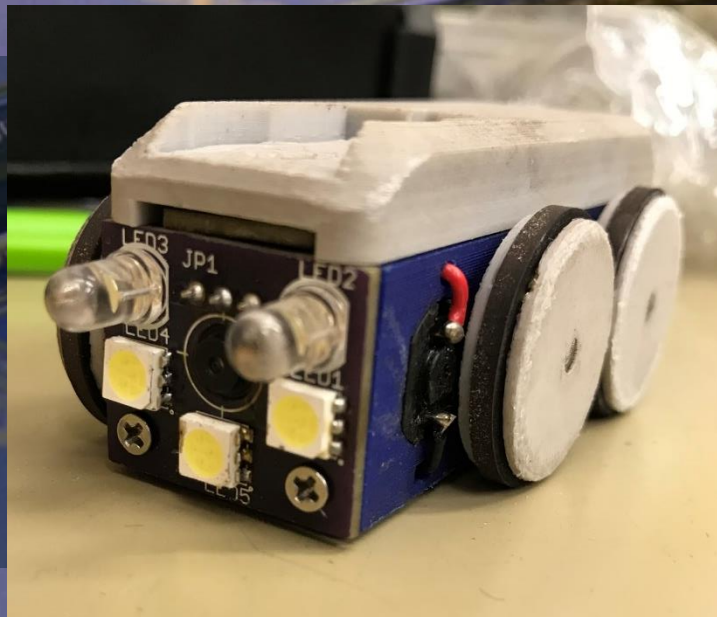
- Remote controlled
- Video feedback recorded for future analysis
- Radiation hardened (~80 rad/hr)
- High temperature environment (~170 F)

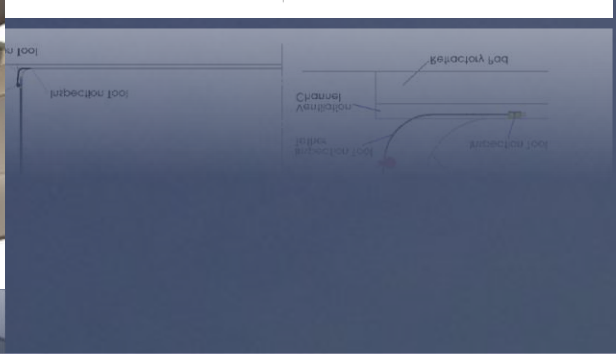
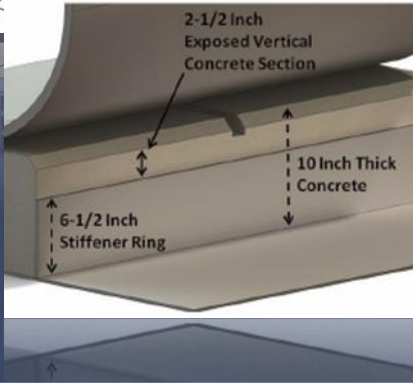
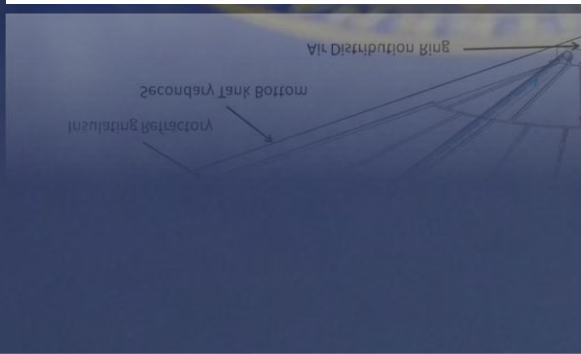
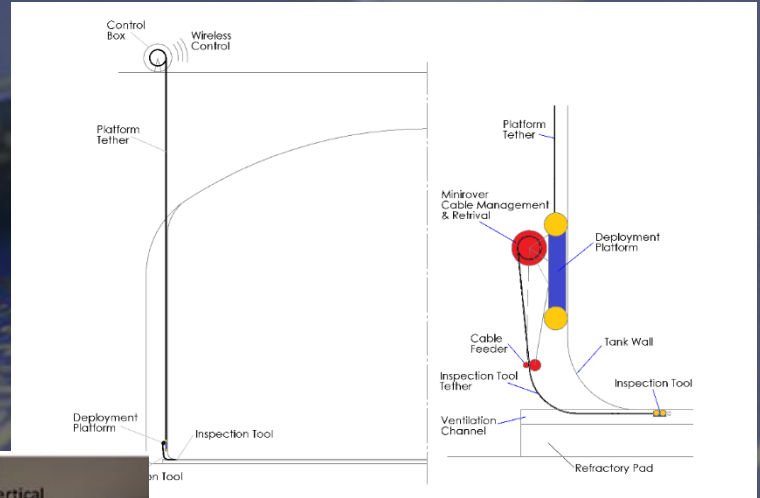
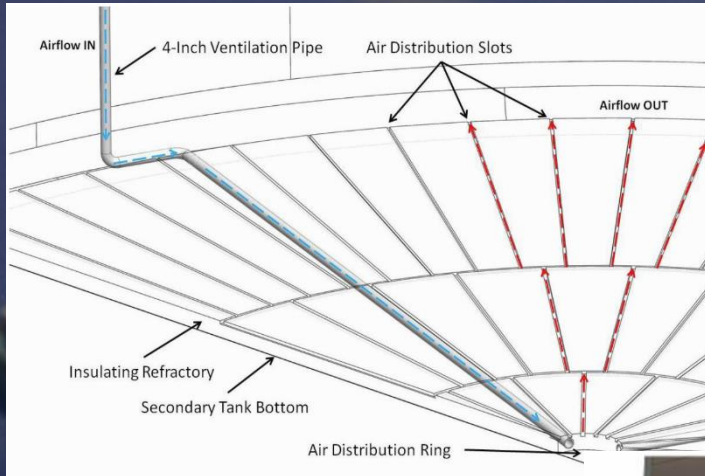


- To be used in pipes and fittings with 3" and 4" diameters
- Will need to turn through elbows, bends, and transitions
- Crawl through vertical runs



*Worlds
Ahead*



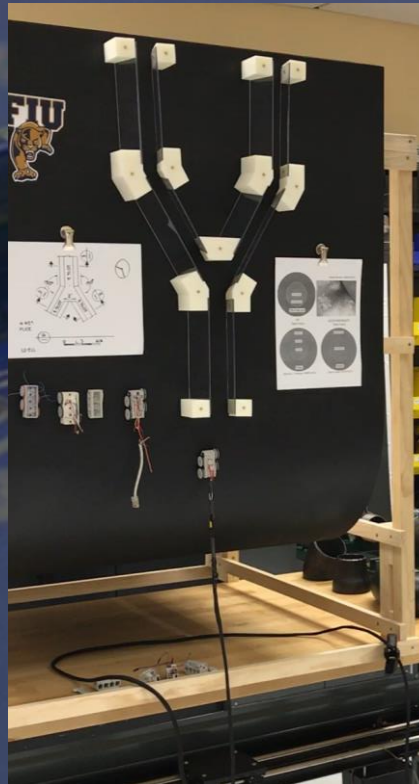


MINIROVER REFRACTORY SLOT INSPECTION TOOL

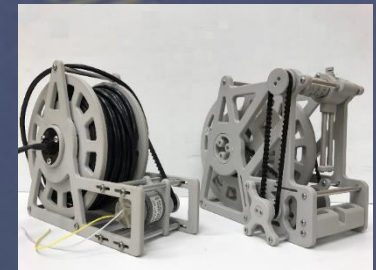
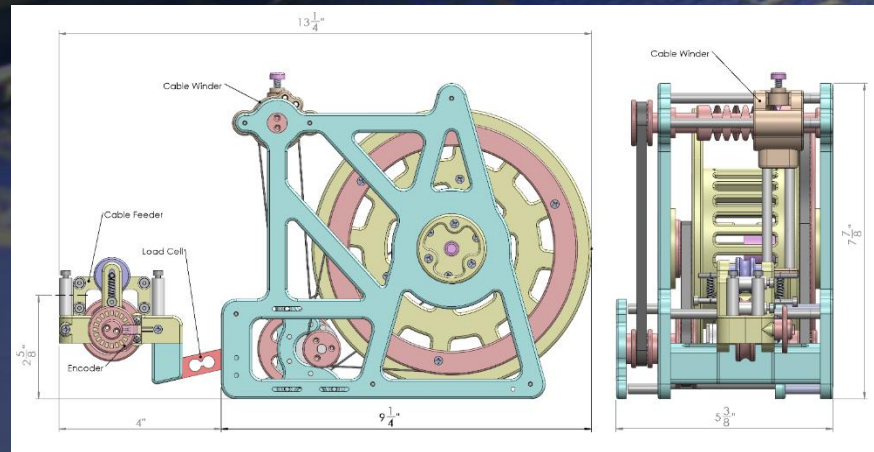
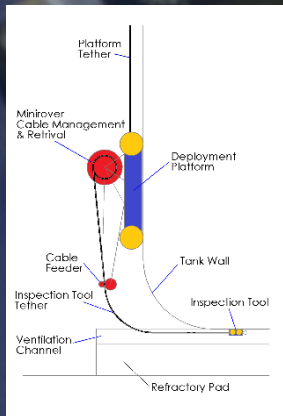
- Travel through small cooling channels
- Remote controlled
- Inserted through a riser to the annulus floor
- Live video feedback



- Radiation hardened (~80 rad/hr)
- High temperature environment (~170 F)
- Must not subject the channel walls to pressures greater than 200 psi
- Tethered



AUTONOMOUS CABLE MANAGEMENT SYSTEM



MOVING FORWARD SEMI-AUTONOMOUS DRIVING

Image Processing Pipeline



(a). Image Stream from Camera



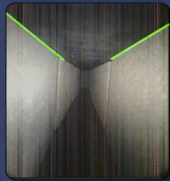
(b). Grayscale and thresholding



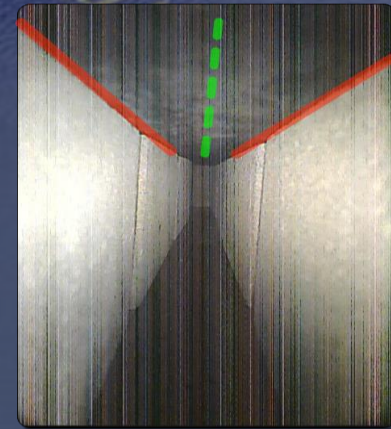
(c). Edge detection



(d). Line Detection

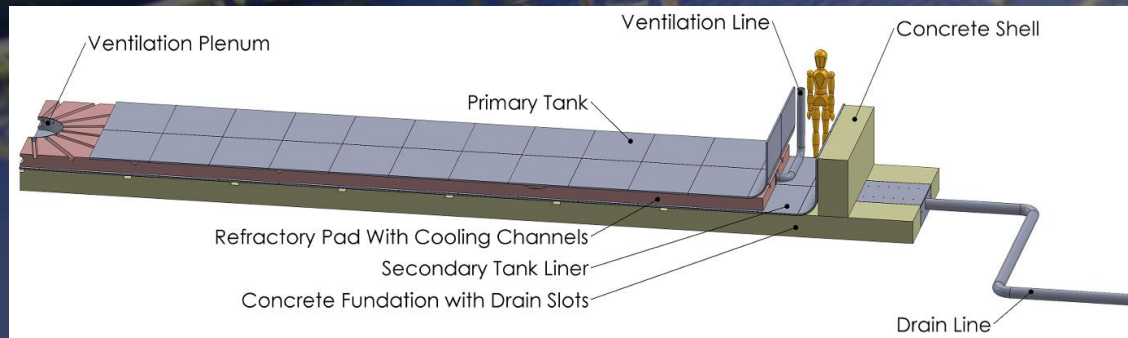


(e). Channel boundary Approximation



MOVING FORWARD

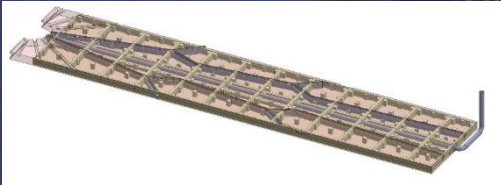
SECTIONAL FULL-SCALE MOCKUP



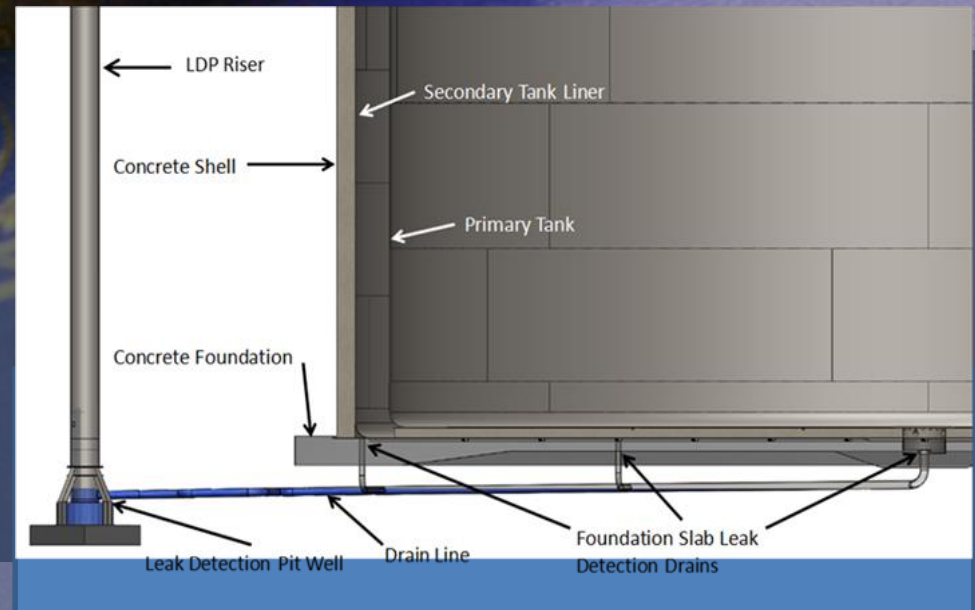
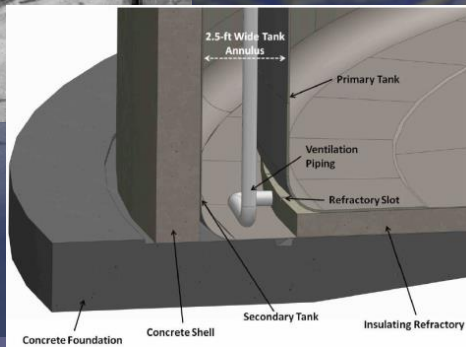
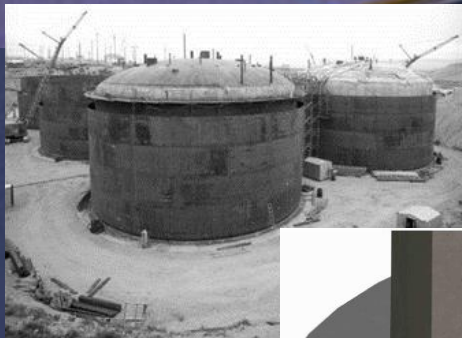
DRAIN SLOTS



AIR SLOTS



HYBRID INSPECTION SECONDARY LINER BOTTOM CORROSION



FINAL WORDS MOVING FORWARD

CRAWLER

- *Develop delivery mechanism for easy development*
- *Provide feedback of other inspection parameters (temperature, relative humidity, radiation, etc.)*
- *Redesign a radiation hardened version*
- *Scale the design for smaller pipe sizes*



ROVER

- *Develop delivery mechanism for easy deployment*
- *Provide feedback of other inspection parameters (temperature, relative humidity, radiation, etc.)*
- *Redesign a radiation hardened version*
- *Autonomous deployment/maneuvering*